VIRGINIA GIS REFERENCE BOOK

General Application Category/Sub Application Name: County Executive & Board of Supervisors

Product /Service/Function Name: Asset Inventory

P/S/F/ Description: An application to allow county executives the ability to manage assets within a locality. Assets can involve real and personal property items. An application of this nature could be enhanced to incorporate work order and/or trouble call systems, preventative maintenance scheduling, and asset resources allocation.

Product /Service/Function

1. Spatial Data:

Spatial Data is information about the location and shape of, and relationships among geographic features, usually stored as coordinates and topology. In general terms, spatial data is a term given to digital information that contains a geographic component.

The most basic format of spatial data is typically in the form of "shape" file (ESRI file format), or a DWG file (AutoCAD file format). These file formats are, for the most part, standards in the GIS industry. This spatial data can be presented within certain software packages in varying degrees of formatting, such as coverages, themes and projects. Spatial data is usually categorized in two ways. Vector spatial data are typically point, line, polyline, or polygon shapes depicting objects or features. Raster spatial data are typically imagery-based data such as orthophotography or image based generated such as digital raster graphics. Raster imagery is typically used as a base layer or frame of reference layer.

- Minimum Requirements: At a minimum, a functioning application that provides a basic level of asset inventory must have spatial data representing the boundaries of each real property asset (i.e. land, facilities, structures, parking lots…) and point or polygon vector data with x and y location information representing personal property locations that are to be tracked (i.e. Vehicles, mechanical equipment, technical equipment and supplies). All point and polygon data should include positional information as well as, at a minimum, unique identifier that will tie to attribute information. Additionally, a spatial raster base data layer will be needed to provide a frame of reference for the desired region. If the above spatial layers are not already compiled then they will need to be created or developed using standard GIS data collection and development processes. All spatial data will need to be in the same coordinate system, projection and file formats.

- Optional Requirements: Additional spatial data layers will enhance the overall usefulness of the GIS. Optional spatial data are environmental data layers such as

hypsography, hydrology, environmental boundaries, and special habitat boundaries. Other vector data are electric, water, sewer access points and lines. Building footprint polygons could be generated instead of points. Multiple base map layers such as digital raster graphics (DRGs) from the USGS or digital elevation model graphics (DEMs) may be added as base map layers in order to convey additional information to the user.

2. Attribute Data

Attribute data are characteristics of a geographic features described by numbers, characters, images or drawings, typically stored in a tabular format and linked to the feature by a user-assigned identifier. In most basic terms attribute data are tabular data in a database structure that link to and hold additional information about corresponding spatial data.

Attribute data will generally be in two forms. One form will be tabular data in a ".dbf" file format which is a component of the ESRI shape file set. These spatial data are typically and best limited to unique identifier column and columns that hold pertinent spatial information such as lat/long information or X/Y positions. Additional attribute information should be housed in a separate typical database structure (ASCII text file, spreadsheet, database) that ties to the unique identifier of the records in the shape file "dbf". These data can contain all additional information that is needed or desired to convey information about a particular spatial element. All data structures and naming conventions should be in standard ANSI formats.

- Minimum Requirements: At a minimum, typical attribute data for asset inventory are the dimensions of the real property such as acreage, name, length, description, acquisition date and resource type.
- Optional Requirements: Optional attribute information could include practically any type of information that could be tied to an asset. Some examples would include life cycle, resale cost, disposition, ownership of asset, category, expanded descriptions, category, maintenance schedule, public event and private event scheduling requirements and schedules, tie to spare parts inventory database, and check-in check-out information.

3. Data Acquisition Options (integrated with VBMP digital orthos):

The majority of spatial data acquisition will typically have to be completed from scratch utilizing fieldwork with field personnel and GPS units. For most localities, attribute data collection will begin with a download or export from an asset/inventory database already in place. If this does not exist or if the asset inventory records are not complete or up-to-date, then physical inventory and cataloging will need to occur. Where possible, acquiring data that has already been developed will be the desired model.

The VBMP digital orthophotography will be one of the best sources for the spatial base map layer. This will be available through arrangements with the Virginia Geographic Information Network. Other possible base map layers may include raster spatial data from the VEDP and USGS.

4. Data Conflation Options (integrated with VBMP digital orthos):

Conflation is the method whereby a geographic feature is adjusted to fit a more accurate base map. This process can occur in variety of ways, with the least sophisticated being a "best-fit" methodology. The best-fit method is a visual inspection or comparison of a geographic feature's current position to where it is or should be located on the more accurate base map.

Another conflation option includes rubber sheeting, a method using control points or existing boundaries to establish the new geographic position of a feature.
Finally, the most accurate method of conflating data includes the use of Global Positioning Satellite technology (GPS), or traditional survey instruments to accurately locate an objects physical location.

5. GUI / Programming Options:

A GUI or graphical user interface is a graphical method of controlling how a user interacts with a computer to perform various tasks. Instead of issuing commands at a prompt, the user performs desired tasks by using a mouse to choose from `a dashboard' of options presented on the display screen. These are in the form of pictorial buttons (icons) and lists. Some GUI tools are dynamic and the user must manipulate a graphical object on the screen to invoke a function; for example, moving a slider bar to set a parameter value (e.g., setting the scale of a map).

There are two main avenues to develop an application and GUI for your GIS data. An application can be stand alone or distributed.

Stand-alone applications are typically built by programming modules, scripts and add-ins to perform specific analyses that are extensions of desktop GIS software packages such as ArcView, ArcInfo or AutoCAD.

Another desktop method would be to program a GUI and application from scratch utilizing a programming language and suite such as MS Visual Basic, FoxPro or C++ and a third party GIS programming suite such as ESRI Map Objects. Workstation based or stand-alone applications are usually developed to perform specific higher-end functions for a user that has a working knowledge of GIS systems.

Typically a distributed application will be shared across an Intranet or the Internet with the user utilizing a thin client such as a browser. An Internet based application will typically utilize a mix of languages to create a finished product. These languages can

include HTML, Java, JavaScript, XML, AXL, Pearl, PHP, JSP, Cold Fusion or MS ASP. Specific knowledge a map server software package such as ESRI's ArcIMS or AutoDesk's Mapguide will be required.

The application should give the user the ability to quickly locate and navigate to an asset or group of assets. Application should allow the user to perform queries or searches for asset by types, categories, maintenance scheduling, geographic location, owner, date acquired and so on. Initial interface will most likely be in the form of tabular searches that produce a result set. From the result set, the user should be able to get additional detailed information about a particular asset or a group of assets. Additionally the user should be able to map the asset or group of assets. Mapping interface should give the user ability to identify assets clicking on an object in the map as well as the ability to select objects and turn specific layers on or off.

6. Internet Functionality and Options

Internet delivery and functionality would provide the public with access to the reservation schedules of park facilities and give administration access to maintenance schedules. Also, the administration could use the application to develop maps for proposed new facilities that could be printed and distributed at meetings. Internet functionality should include basic GIS functions available in a thin client GIS application, such as ESRI's ArcExplorer (i.e. Zoom In, Zoom Out, Pan, Identify, Query, etc.).

Additional functionality may include appropriate hyperlinks to critical and related information on the Internet related to certain queries or operations within the application. A dedicated "needs based" approach to determine user interface options and functionality is highly recommended before actual application work is to begin. There are many Internet based map server technologies available on the market today and great care should be taken to evaluate the different options when selecting the software and programming language option that will be utilized for your application.

7. Technical Requirements

Technical requirements will vary greatly depending on whether the application programming, development and hosting functions are in-house or if the functions are outsourced to a GIS applications development and hosting firm. Obviously, the situation that would require the least amount of technical requirements and resources would be to outsource to a firm that already has all the technical requirements and experience in place. However, for the purposes of this paper, we will assume that all of the development and hosting will occur in-house. Some of the resources listed below may already be within the existing pool of resources at some organizations.

- Minimum: A Basic working knowledge of a leading GIS software, and Internet Browser are required. A Pentium III or greater CPU, with a minimum of 128MB Ram, 16MB Video Card, is required. A higher speed Internet connection is recommended for GIS Internet application deployment and analysis.

Most leading GIS software is customizable using MS Visual Basic or other common language. It is suggested that the developer have a working knowledge of at least Visual Basic before attempting GUI development.

- Optimum: In the case where a local government employs a capable information Technology Department, other languages may be considered, such as JSP, Java, Visual Basic, ASP, and Cold Fusion. In most cases, these languages are related to Internet application development. A web developer with three years of experience should be able to customize and/or develop a unique Internet Map Server application.

8. Administrative / Management Requirements

Management concerns will involve technical support, system maintenance and, of course, human resource management issues of a technical product. These issues are minimized if the maintenance and/or hosting of the application are contracted to a GIS application development and hosting organization. Technical and administrative issues become more critical and consuming when developing. and/or hosting an application in-house. General expertise in GIS is suggested if outsourcing an application development and hosting. In-house application development and hosting will require GIS specialist human resources, advanced web programming human resources, and significant technical material resources (hardware/software).

9. Cost – Cost/Benefit

The cost of developing an asset inventory application could range from $55,000 to $90,000 depending upon the level of functionality, use, and the outsourcing of components involved. See below for an approximate and general breakdown of costs that may be incurred when developing an application in-house. Please note that the figures below are very general and basic estimations.

Hardware Costs: (Assuming Internet Deployment)

Item	**Units**	**Cost**	**Total**
Development Server	1	2,500	2,500
Production Server	1	5,000	5,000
GPS Units	3	1,000	3,000
Back-up System	1	3,500	3,500
Router	1	2,500	2,500
CSU/DSU	1	500	500
Dedicated Bandwidth	12	1,000	12,000
UPS for Computers	2	250	500
Total			**29,500**

Software Costs: (Assuming single processor based licensing)

Item	**Units**	**Cost**	**Total**

Operating System	1	1,000	2,500
Database Server	1	4,500	4,500
Map Server	1	7,500	7,500
Application Server	1	1,500	1,500
Java Server	1	1,000	1,000
Desktop GIS Package	2	1,500	3,000
Program Editor	1	650	650
Total			**20,650**

In-House Development Human Resource Costs:
(Assuming Internet Deployed Application and 6 month development cycle)

Item	**Man/Hours**	**Utilization over 6 months**	**Hourly Cost**	**Total**
GIS Specialist/Technician	160	20%	17.5	2,800
Field Personnel/Research	600	35%	15	9,000
Network/System Admin	240	24%	25	6,000
Programmer(s)	1000	100%	35	35,000
Manager	140	14%	25	3,500
Total[1]				**56,300**

On-going Application Maintenance/Enhancements (after development):
(Assuming Internet Deployed Application over 12 months)

Item	**Man/Hours**	**Utilization over 6 months**	**Hourly Cost**	**Total**
GIS Specialist/Technician	120	15%	17.5	2,100
Network/System Admin	25	7.5%	25	625
Programmer(s)	220	22%	35	7,700
Manager	25	7.5%	25	625
Total[1]				**11,050**

On-going Application Hosting (after development):
(Assuming Internet Deployed Application over 12 months)

Item	**Units**	**Unit Cost**	**Total**
Dedicated Bandwidth	12	1,000	12,000
Total			**12,000**

[1] Please note that the above human resources are rough estimates of hours for man-hours needed to perform some data collection and data development processes as well as the application development process. If the above human resources are not currently on staff and available for a project of this nature, then resources would need to be acquired on a full-time basis. This is not feasible unless there is sufficient cause and workload to occupy these human resources for the additional hours above the utilization column above.

As indicated from the above estimates, developing the initial application could range in the $90,000 range. On-going maintenance, enhancements and hosting could be in the $25,000 range. Out-sourcing the development and hosting functions to a qualified/experienced applications development firm could realistically cut the initial development costs by 50% and cut the ongoing maintenance and hosting costs by 75%.

The cost/benefit is highly favorable if the system is to incorporate preventative maintenance and trouble call capabilities. An application of this nature would allow for efficient and effective asset identification, trouble call routing and maintence, which would more than pay for the development over a period of months or years.

The benefit to county executives and board of supervisors is somewhat intangible, yet positive in the form of providing improved public and business services, providing better decision making information and possibly allowing for quicker resolution of some issues. The fact that county executives are utilizing technology and GIS to be better informed will most likely increase or initiate a positive perception of their abilities.

Additionally, Internet functionality of this application would allow for increased interaction and communication between the general public and the locality. This would be especially true for the parks and recreation department to allow for public and private scheduling/renting of real or personal locality property.

10. Standards / Guidelines Summary

All GIS or spatial data should be delivered, collected or developed in a format and projection that matches the VBMP ortho base map. The attribute, or tabular data, provided by 3rd party entities should be in a standard database format, spreadsheet format or ASCII delimited text file format.

When and where possible approach the application development process in phases. This type of application will be very data centric or rely on data a great deal for usefulness to the intended user. Develop a basic database application as a first step and then add the mapping functionality and the administrative and "back-end" functions in a later phase. This process will help keep the project manageable and allow for dispersed budgeting.

As with most all data, providing a source for the information portrayed as well as including disclaimer information is highly recommended.

Referencing standards and guidelines that are pertinent to and relate to asset inventory management is recommended.

11. Startup Procedures/Steps

- Application Outline / Blueprint: Application purpose, interface design, functionality, queries and "look and feel" should be determined and documented as an initial step. Stakeholders should be involved in this step.
- Data Acquisition: The attribute data should be obtained from the various sources mentioned earlier and normalized and related where necessary. Spatial data can be downloaded from a variety of sources listed above. If spatial data is not available then it will need to be collected and developed.
- Sourcing Determination: Determine entity/entities that will be performing data development functions, application development functions and application hosting functions and create a project plan with budget numbers.
- Develop a implementation plan that includes timelines and milestones.
- Develop a data development/transformation plan that includes metadata definitions, database schema, and data dictionaries with relational information.
- Readdress your project plan, timelines and budgets as a final initial process before committing resources.
- It is recommended that the database application functions be addressed and implemented before the mapping functions.

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12. Estimated Time Line and/or Implementation (stand alone) schedule

The estimated time to develop this application varies based on functionality. This can be as little as three months or as much as 12 months. Typically this type of application can be developed in approximately 6 months. Data collection and development functions will add to the timeline. A sample timeline is offered below as a generic application development cycle.

Function	**Time**
Data collection/Research	3 months
Data development	1 month
Application Planning/Documentation	1 month
Application development	6 months
Application staging/testing	1 month

Total time line	**12 months**

13. Best Practice Example in Virginia:

The best example of this application would be a project that happens every two years at Fort AP Hill in Virginia. The Boy Scouts of America hold their national Jamboree at this location and within a matter of a week set-up what amounts to a small city. All materials and assets involved in the Jamboree are spatially located. Inventory management, logistical functions, vendor purchasing and buyback functions are all enhanced by the use of an application, which utilizes spatial data as a core component. This is not a public application, so inquiries regarding this application and project can be directed to Daniel Shaffer with Terralogic, Inc. 540-213-2447.